ALLOYS MAKE LOSING WEIGHT EASY

Aluminum-beryllium alloys fill the need for stiff, lightweight materials in golf clubs, communications satellites, and computer disk drives.

■ Precision investment-cast Beralcast® components (pictured above) are used in a wide variety of aerospace, defense, and commercial applications.

Manufacturers have long recognized beryllium for its superior attributes—its light weight, high stiffness, and superior ductility. But the dark grey metal is expensive and brittle, making it difficult to mass-produce into parts, especially complex ones. So far, commercial industries have shied away from using beryllium in their products, resorting to less exotic materials such as aluminum.

Over the years, many attempts have been made to combine beryllium and aluminum, which could theoretically produce parts that perform better than those made of conventional materials, at a price much more affordable than that of pure beryllium. Although simple enough in concept, the alloy's production was hindered for many years because conventional manufacturing techniques were inefficient and wasteful.

Starmet Corporation (Concord, MA), formerly Nuclear Metals, Inc., has developed a method for mass-producing parts made from a family of materials called Beralcast® using aluminum-beryllium alloys. Its casting process allows very complex near-net and net shapes to be fabricated with little or no finished machining—an industry first. In general, any part that can be investment cast in aluminum can also be investment cast in Beralcast. For example, aluminum-based armatures and support structures for high-end computer disk drives and communications satellites, respectively, have been successfully reproduced in Beralcast.

Successful trio. The key to Starmet's success is three new alloys, namely Beralcast 363, 191, and 310. These materials have a fine-grain, homogenous, as-cast microstructure. Their composition is designed to minimize the effects of segregation, porosity, and low strengths. Therefore, they can be readily cast into complex shapes with greatly improved strength and ductility and significantly reduced weight, as compared with other competing materials. Starmet developed the Beralcast process several years ago with validation funding from BMDO contracts for ballistic missile defense systems.

Although difficult to achieve, Starmet's breakthrough provides important technology for weight-critical and stiffness-critical programs. "In making Beralcast alloys, it took us over 400 attempts to find the right combinations of aluminum, beryllium, and trace elements," says Frank Vumbaco, Starmet's vice president of corporate communications. "Beralcast parts are 22 percent lighter than alu-

minum components but have the stiffness of steel. Because of this stiffness, parts can be redesigned using thinner walls. As a result, finished Beralcast parts could weigh half as much as aluminum ones."

Starmet's development of Beralcast led to the spinning out or formation of several companies, including two wholly owned subsidiaries, Starmet Commercial Casting and Starmet Aerocast. Another company, TrioStar, also formed to take advantage of Beralcast. In 1997, several commercial and military groups established agreements with these companies to use Beralcast in their systems.

For example, Starmet Commercial Casting has received more than $1 million in contracts from four major companies to use Beralcast material in high-end computer disk drives. Armatures made of Beralcast alloys allow disk drives to retrieve more electronic data at a faster rate than those made from aluminum because the material's stiffness and resulting damping qualities are 4 to 10 times better than aluminum, depending on the driving and resonance frequencies. Starmet Commercial Casting has been manufacturing prototype Beralcast components and expects to mass-produce computer disk drive armatures in mid-1999.

Flying high. Teaming with Advanced Product Laboratories and R-Cubed Composites, Starmet Commercial Casting also formed a joint venture corporation in late 1997, called TrioStar (West Jordan, UT). TrioStar offers the unique capability to integrate resin matrix composite and metallic structures into a unified design for application in such weight-critical programs as low-Earth-orbiting satellites for global communications networks. The bulk of the technology also surrounds Starmet's patented family of Beralcast alloys. Because Beralcast is light in weight, has a high modulus of elasticity, and can be precision cast for three-dimensional material stability, these alloys are attractive for advanced sensor and guidance structures in flight and satellite systems.

On a lighter note, Starmet is investigating the use of Beralcast in golf clubs and high-end racing bicycles. Working with several equipment manufacturers, the company is testing Beralcast alloys for replacing the club's head and shaft, which may increase the speed of the user's swing. It also has supplied Beralcast alloys to Beyond Fabrications, producers of beryllium-based bicycles. The Beralcast frames of these bikes weigh about two pounds, which is about half the weight of aluminum frames.

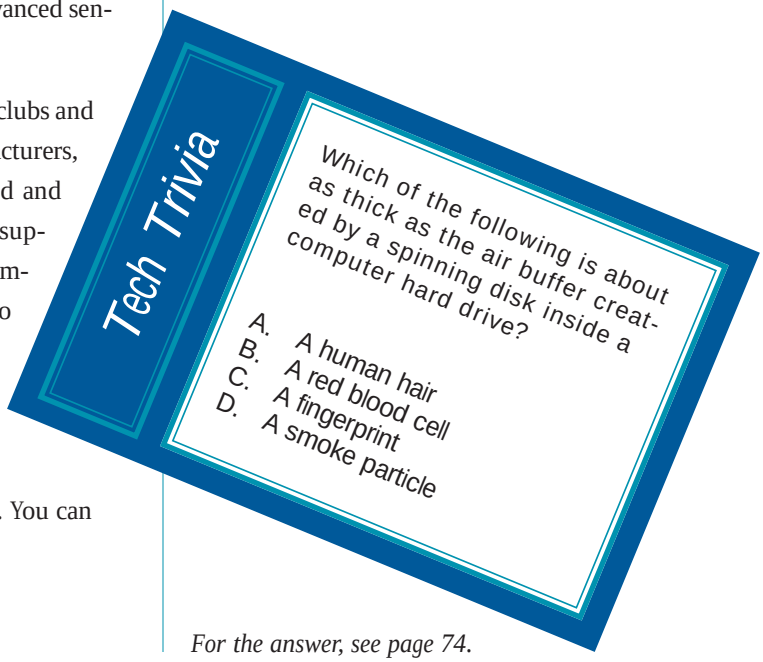
■ For more information, contact Frank Vumbaco via telephone at (978) 369-5410, ext. 296, or via E-mail at fvumbaco@starmet.com. You can also visit Starmet's Web site at http://www.starmet.com.

What Does It Mean to You?

Beralcast alloys will be greatly appreciated by both computer users and sports enthusiasts, allowing manufacturers to produce faster, larger hard disk drives and lighter, stronger golf clubs.

What Does It Mean to Our Nation?

Beralcast alloys will lower costs in weight-critical programs such as low-Earth-orbiting satellites for global communications networks, enabling commercial and government space programs to reduce mission budgets.



For the answer, see page 74.